

## TENT COOPERATION TRE, Y

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
 United States Patent and Trademark  
 Office  
 Box PCT  
 Washington, D.C.20231  
 ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 22 October 1999 (22.10.99)	
International application No. PCT/FI99/00096	Applicant's or agent's file reference 18014 WO
International filing date (day/month/year) 09 February 1999 (09.02.99)	Priority date (day/month/year) 17 February 1998 (17.02.98)
Applicant SALONAH, Oscar et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

09 September 1999 (09.09.99)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
 34, chemin des Colombettes  
 1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

F. Baechler

Telephone No.: (41-22) 338.83.38

# PATENT COOPERATION TREATY

FJ

From the INTERNATIONAL SEARCHING AUTHORITY

## PCT

To:

Johansson Folke  
c/o Nokia Corporation  
P.O.Box 226  
FIN-00045 NOKIA GROUP  
Finland

0 2. 09.

99

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NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT  
OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing  
(day/month/year)

2 8 -07- 1999

Applicant's or agent's file reference  
18014 WO

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.  
PCT/FI99/00096

International filing date  
(day/month/year)  
09-02-1999

Applicant  
Nokia Telecommunications OY  
et al

1. ☒ The applicant is hereby notified that the international search report has been established and is transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

**When?** The time limit for filing such amendments is normally 2 months from the date of transmittal of the international search report; however, for more details, see the notes on the accompanying sheet.

**Where?** To the International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland  
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
- ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.
  - ☐ no decision has been made yet on the protest: the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the ISA/  
Patent- och registreringsverket  
Box 5055  
S-102 42 STOCKHOLM  
Facsimile No. 08-667 72 88

Telex  
17978  
PATOREG-S

Authorized officer

Jessica Kumlin

Telephone No. 08-782 25 00

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>18014</b>	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/FI 99/00096</b>	International filing date ( <i>day/month/year</i> ) <b>9 February 1999</b>	(Earliest) Priority Date ( <i>day/month/year</i> ) <b>17 February 1998</b>
Applicant <b>Nokia Telecommunications Oy et al</b>		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (See Box I).
2. ☐ Unity of invention is lacking (See Box II).
3. ☐ The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing
  - ☐ filed with the international application.
  - ☐ furnished by the applicant separately from the international application,
    - ☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
  - ☐ transcribed by this Authority.
4. With regard to the title, ☒ the text is approved as submitted by the applicant.
  - ☐ the text has been established by this Authority to read as follows:
5. With regard to the abstract,
  - ☒ the text is approved as submitted by the applicant.
  - ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. The figure of the drawings to be published with the abstract is:
  - Figure No. 2 ☒ as suggested by the applicant. ☐ None of the figures.
  - ☐ because the applicant failed to suggest a figure.
  - ☐ because this figure better characterizes the invention.

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/38

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9504419 A1 (BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY), 9 February 1995 (09.02.95), page 3, line 26 - page 5, line 20; page 9, line 20 - page 10, line 6; page 11, line 15 - page 12, line 24 --	1,26,28,29
A	US 5594949 A (CLAES H. ANDERSSON ET AL), 14 January 1997 (14.01.97), column 6, line 26 - column 7, line 7 --	1,26,28,29
P,A	WO 9857512 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 17 December 1998 (17.12.98), page 4, line 9 - line 11; page 4, line 19 - line 29 -- -----	1,26,28,29

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

28 July 1999

Date of mailing of the international search report

28 -07- 1999

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Jaana Raivio/mj

Telephone No. +46 8 782 25 00

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

01/07/99

International application No.  
PCT/FI 99/00096

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
WO	9504419	A1	09/02/95	AU	680281 B	24/07/97
				AU	7270094 A	28/02/95
				CA	2168256 A	09/02/95
				CN	1128094 A	31/07/96
				EP	0711482 A	15/05/96
				FI	960389 A	29/01/96
				JP	9501284 T	04/02/97
				NZ	269203 A	27/07/97
				SG	47621 A	17/04/98
-----						
US	5594949	A	14/01/97	US	5375123 A	20/12/94
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WO	9857512	A1	17/12/98	AU	8046298 A	30/12/98

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

3 0. 05. 2000

PCT

31.5.00

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

To:

JOHANSSON, Folke  
Nokia Corporation  
P.O. Box 226  
FIN-00045 Nokia Group  
FINLANDE

Date of mailing  
(day/month/year) 25.05.2000

Applicant's or agent's file reference  
18014 WO

IMPORTANT NOTIFICATION

International application No.  
PCT/FI99/00096

International filing date (day/month/year)  
09/02/1999

Priority date (day/month/year)  
17/02/1998

Applicant  
NOKIA NETWORKS OY et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer

Scaglia, F

Tel. +49 89 2399-2836




# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>18014 WO</b>		<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. <b>PCT/FI99/00096</b>	International filing date (day/month/year) <b>09/02/1999</b>	Priority date (day/month/year) <b>17/02/1998</b>	
International Patent Classification (IPC) or national classification and IPC <b>H04Q7/38</b>			
Applicant <b>NOKIA NETWORKS OY et al.</b>			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the report</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input checked="" type="checkbox"/> Certain defects in the international application</li> <li>VIII <input checked="" type="checkbox"/> Certain observations on the international application</li> </ul>			
Date of submission of the demand <b>09/09/1999</b>		Date of completion of this report <b>25.05.2000</b>	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized officer  <b>Rabe, M</b>  Telephone No. +49 89 2399 8801	



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/FI99/00096

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-19 as published

**Claims, No.:**

1-30 as published

**Drawings, sheets:**

1/9-9/9 as published

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/FI99/00096

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	2-25,27,30
	No:	Claims	1,26,28,29
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-30
Industrial applicability (IA)	Yes:	Claims	1-30
	No:	Claims	

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

Reference is made to the following documents:

D1: WO 95/04419

D2: US-A-5 594 949

**A. Citations and explanations made in respect of paragraph V:**

1. Document **D1** (see in particular page 1, line 5 to page 5, line 20; page 9, line 20 to page 11, line 18; Figure 1) discloses, in accordance with **all** the features of **claim 1**, a method of measurement reporting in a telecommunication system (see in particular page 1, lines 5 to 8; page 1, line 35 to page 2, line 19; page 3, line 26 to page 4, line 6; Figure 1) comprising mobile stations (see "1" in Figure 1) and a network comprising base stations (see "2" in Figure 1), wherein decisions upon establishing or cancelling a link between a mobile station and a base station are made in the network on the basis of measurement reports sent from the mobile station to the network (see in particular page 3, lines 26 to 32), the method comprising the steps of:

defining at least two independent measurement report triggering conditions (see in particular page 9, lines 30 to 32; page 11, lines 15 to 18);

monitoring at the mobile station properties of a plurality of radio signals received from respective base stations (see in particular page 4, lines 13 to 22; page 5, lines 10 to 20; page 10, lines 32 to 35; "4d" in Figure 1);

generating a measurement report comprising information about the monitored radio signals at the mobile station when at least one of the triggering conditions is met (see in particular page 10, lines 29 to 35); and

transmitting the generated measurement report to the network (see in particular page 10, lines 1 to 6 and 34 to 35).

The subject-matter of claim 1 therefore is **not new**, Article 33 (2) PCT.

It should furthermore be noted that even if novelty of claim 1 could be argued, based on minor differences between the features of claim 1 and those disclosed in document **D1**, the subject-matter of said claim would **not involve an inventive step**, Article 33 (3) PCT, having regard to the disclosure of document **D1** and the

normal knowledge of a person skilled in the art of mobile communications systems and related measurement reporting technologies (see eg. also document **D2**, in particular column 6, lines 15 to 18; column 6, line 62 to column 7, line 2).

2. Furthermore, document **D1** (see in particular page 1, line 5 to page 5, line 20; page 9, line 20 to page 11, line 18; Figure 1) discloses, in accordance with **all** the features of respective **independent claims 26 and 28**, a telecommunication network and, respectively, a network element for a telecommunication network for a telecommunication system comprising mobile stations (see "1" in Figure 1) and a network comprising base stations (see "2" in Figure 1), wherein the mobile stations monitor radio signals sent by the base stations (see in particular page 1, lines 5 to 8; page 1, line 35 to page 2, line 19; page 3, line 26 to page 4, line 6; Figure 1), comprising
  - determining means for determining a plurality of independent trigger conditions for triggering the transmission of a measurement report from the mobile station (see in particular page 9, lines 30 to 32; page 11, lines 15 to 18); and
  - sending means responsive to the determining means for sending the determined trigger conditions to a mobile station (see in particular page 10, lines 14 to 35).

The subject-matter of respective claims 26 and 28 therefore is **not new**, Article 33 (2) PCT.

It should furthermore be noted that even if novelty of said respective claims 26 and 28 could be argued, based on minor differences between the features of respective claims 26 and 28 and those disclosed in document **D1**, the subject-matter of said claims would **not involve an inventive step**, Article 33 (3) PCT, having regard to the disclosure of document **D1** and the normal knowledge of a person skilled in the art of mobile communications systems and related measurement reporting technologies (see eg. also document **D2**, in particular column 6, lines 15 to 18; column 6, line 62 to column 7, line 2).

3. The same considerations as made in above paragraph 1 relating to lack of novelty and inventive step of claim 1 are also valid for **independent claim 29** since claim 29 is based essentially on the same principle as claim 1 in terms of a mobile sta-

tion.

The subject-matter of independent claim 29 therefore **is neither new**, Article 33 (2) PCT, **nor does it** involve an inventive step, Article 33 (3) PCT.

4. **Dependent claims 2 to 25, 27 and 30** do **not** appear to contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step for the reason that the subject-matter of said claims **either is in principle** directly derivable from the disclosure of document **D1** (see in particular page 1, line 5 to page 5, line 20; page 9, line 20 to page 11, line 18; Figures 1, 2 and 5) or document **D2** (see in particular column 4, lines 11 to 44; column 6, line 15 to column 7, line 2), **or** represents minor design details which are based on the general knowledge of the person skilled in the art of mobile communications systems and related measurement reporting technologies (see eg. the prior art acknowledged by the applicant himself in the present description on page 1, line 16 to page 4, line 26).

Dependent claims 2 to 25, 27 and 30 therefore **do not** meet the requirements of Article 33 (3) PCT.

**B. Remarks made in respect of paragraph VII:**

1. To meet the requirements of Rule 5.1 (a) (ii) PCT, the documents **D1** and **D2**, which represent a relevant state of the art with regard to the present invention, should have been identified in the opening part of the description and the relevant background art disclosed therein should have been briefly discussed.
2. To meet the requirements of Rule 6.3 (b) PCT, any independent claim should have been **correctly** cast in the **two-part form**, with those features which in combination are part of the nearest prior art (eg. document **D1**) being placed in the preamble.
3. **Reference signs** in parentheses should have been inserted in all the claims to increase their intelligibility, Rule 6.2 (b) PCT. This applies both to the preamble

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/FI99/00096

and to the characterizing portion.

**C. Remarks made in respect of paragraph VIII:**

The following amendments would have been necessary to the **claims**:

1. It is clear from the description on page 1, line 35 to page 2, line 1, on page 17, line 30 to page 18, line 2 and on page 18, lines 27 to 28, that the following features are essential to the definition of the invention:

The method comprises the steps of defining **in the network** at least two independent measurement report triggering conditions, **sending said triggering conditions to the mobile station**, monitoring ...

Since **claim 1** does not contain these features it does not meet the requirement following from Article 6 PCT taken in combination with Rule 6.3(b) PCT that any independent claim must contain all the technical features essential to the definition of the invention.

It should however be noted that, even if these features were included in claim 1, claim 1 would not meet the requirements of Article 33 (2) and (3) PCT in respect of novelty and inventive step, having regard to the disclosure of document D1 (see for these features in particular page 9, lines 30 to 32; page 10, lines 14 to 35; page 11, lines 15 to 18).

2. Although **claims 26 and 28** have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought (ie. claim 26 relates to a telecommunication network and claim 28 relates to a network element for a telecommunication network); claims 26 and 28 include the same feature combination, ie. said claims are of **overlapping scope** and therefore **lack conciseness**.

Moreover, **lack of clarity** of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/FI99/00096

which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

Hence, claims 26 and 28 do **not** meet the requirements of Article 6 PCT. In order to overcome this objection, it would appear appropriate to file an amended set of claims defining the relevant subject-matter in terms of a **single** independent claim relating either to the telecommunication network or to the network element.

3. The wording of respective **claims 7 and 8** should be: "A method according to claim 6, **characterized in that** the network uses a CDMA air interface ..." (Article 6 PCT).

## PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

09.12.1999

JOHANSSON,  
Nokia Corporation  
P.O. Box 226  
FIN-00045 Nokia Group  
FINLANDE
☐ Comp. record  
☐ Prior Art/Salo  
☐ Prior Art/IDS  
☒ Attorney  
☐ CC:

SN

Date of mailing (day/month/year) 29 November 1999 (29.11.99)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 18014 WO	
International application No. PCT/FI99/00096	International filing date (day/month/year) 09 February 1999 (09.02.99)

## 1. The following indications appeared on record concerning:

☒ the applicant    ☐ the inventor    ☐ the agent    ☐ the common representative

## Name and Address

NOKIA TELECOMMUNICATIONS OY  
Keilalahdentie 4  
FIN-02150 Espoo  
Finland

## State of Nationality

FI

## State of Residence

FI

## Telephone No.

## Facsimile No.

## Teleprinter No.

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person    ☒ the name    ☐ the address    ☐ the nationality    ☐ the residence

## Name and Address

NOKIA NETWORKS OY  
Keilalahdentie 4  
FIN-02150 Espoo  
Finland

## State of Nationality

FI

## State of Residence

FI

## Telephone No.

## Facsimile No.

## Teleprinter No.

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

☒ the receiving Office    ☐ the designated Offices concerned  
☐ the International Searching Authority    ☒ the elected Offices concerned  
☒ the International Preliminary Examining Authority    ☐ other:
The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

## Authorized officer

S. De Michiel

Telephone No.: (41-22) 338.83.38

# PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

## NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

JOHANSSON, Folke  
Nokia Corporation  
P.O. Box 226  
FIN-00045 Nokia Group  
FINLANDE

03.02.99

Date of mailing (day/month/year) 26 August 1999 (26.08.99)		IMPORTANT NOTICE	
Applicant's or agent's file reference 18014 WO			
International application No. PCT/FI99/00096	International filing date (day/month/year) 09 February 1999 (09.02.99)	Priority date (day/month/year) 17 February 1998 (17.02.98)	
Applicant NOKIA TELECOMMUNICATIONS OY et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:  
AU,CN,EP,IL,JP,KP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,  
ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,  
SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on  
26 August 1999 (26.08.99) under No. WO 99/43178

### REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

### REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer J. Zahra Telephone No. (41-22) 338.83.38
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## PATENT COOPERATION TREATY

PCT

INFORMATION CONCERNING ELECTED  
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

From the INTERNATIONAL BUREAU

To:

JOHANSSON, Folke  
Nokia Corporation  
P.O. Box 226  
FIN-00045 Nokia Group  
FINLANDE X

9. 10. 99

B

Date of mailing (day/month/year) 22 October 1999 (22.10.99)		
Applicant's or agent's file reference 18014 WO		IMPORTANT INFORMATION
International application No. PCT/FI99/00096	International filing date (day/month/year) 09 February 1999 (09.02.99)	Priority date (day/month/year) 17 February 1998 (17.02.98)
Applicant NOKIA TELECOMMUNICATIONS OY et al		

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

AP : GH, GM, KE, LS, MW, SD, SZ, UG, ZW

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National : AU, BG, BR, CA, CN, CZ, DE, IL, JP, KP, KR, MN, NO, NZ, PL, RO, RU, SE, SK, US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

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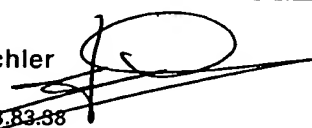
OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG

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TR, TT, UA, UG, UZ, VN, YU, ZW

3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed until 31 months from the priority date for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No. (41-22) 740.14.35	Authorized officer:  F. Baechler   Telephone No. (41-22) 308.83.88
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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>18014 WO</b>	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. <b>PCT/FI99/00096</b>	International filing date (day/month/year) <b>09/02/1999</b>	Priority date (day/month/year) <b>17/02/1998</b>
International Patent Classification (IPC) or national classification and IPC <b>H04Q7/38</b>		
Applicant <b>NOKIA NETWORKS OY et al.</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 8 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand  <b>09/09/1999</b>	Date of completion of this report  <b>25.05.2000</b>
Name and mailing address of the international preliminary examining authority:   <b>European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465</b>	Authorized officer  <b>Rabe, M</b>  Telephone No. +49 89 2399 8801  

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/FI99/00096

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-19                      as published

**Claims, No.:**

1-30                      as published

**Drawings, sheets:**

1/9-9/9                      as published

2. The amendments have resulted in the cancellation of:

- ☐ the description,              pages:  
☐ the claims,                      Nos.:  
☐ the drawings,                      sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/FI99/00096

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	2-25,27,30
	No:	Claims	1,26,28,29
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-30
Industrial applicability (IA)	Yes:	Claims	1-30
	No:	Claims	

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**Reference is made to the following documents:**

**D1:** WO 95/04419

**D2:** US-A-5 594 949

**A. Citations and explanations made in respect of paragraph V:**

1. Document **D1** (see in particular page 1, line 5 to page 5, line 20; page 9, line 20 to page 11, line 18; Figure 1) discloses, in accordance with **all** the features of **claim 1**, a method of measurement reporting in a telecommunication system (see in particular page 1, lines 5 to 8; page 1, line 35 to page 2, line 19; page 3, line 26 to page 4, line 6; Figure 1) comprising mobile stations (see "1" in Figure 1) and a network comprising base stations (see "2" in Figure 1), wherein decisions upon establishing or cancelling a link between a mobile station and a base station are made in the network on the basis of measurement reports sent from the mobile station to the network (see in particular page 3, lines 26 to 32), the method comprising the steps of:
  - defining at least two independent measurement report triggering conditions (see in particular page 9, lines 30 to 32; page 11, lines 15 to 18);
  - monitoring at the mobile station properties of a plurality of radio signals received from respective base stations (see in particular page 4, lines 13 to 22; page 5, lines 10 to 20; page 10, lines 32 to 35; "4d" in Figure 1);
  - generating a measurement report comprising information about the monitored radio signals at the mobile station when at least one of the triggering conditions is met (see in particular page 10, lines 29 to 35); and
  - transmitting the generated measurement report to the network (see in particular page 10, lines 1 to 6 and 34 to 35).

The subject-matter of claim 1 therefore is **not new**, Article 33 (2) PCT.

It should furthermore be noted that even if novelty of claim 1 could be argued, based on minor differences between the features of claim 1 and those disclosed in document **D1**, the subject-matter of said claim would **not involve an inventive step**, Article 33 (3) PCT, having regard to the disclosure of document **D1** and the

normal knowledge of a person skilled in the art of mobile communications systems and related measurement reporting technologies (see eg. also document **D2**, in particular column 6, lines 15 to 18; column 6, line 62 to column 7, line 2).

2. Furthermore, document **D1** (see in particular page 1, line 5 to page 5, line 20; page 9, line 20 to page 11, line 18; Figure 1) discloses, in accordance with **all** the features of respective **independent claims 26 and 28**, a telecommunication network and, respectively, a network element for a telecommunication network for a telecommunication system comprising mobile stations (see "1" in Figure 1) and a network comprising base stations (see "2" in Figure 1), wherein the mobile stations monitor radio signals sent by the base stations (see in particular page 1, lines 5 to 8; page 1, line 35 to page 2, line 19; page 3, line 26 to page 4, line 6; Figure 1), comprising
  - determining means for determining a plurality of independent trigger conditions for triggering the transmission of a measurement report from the mobile station (see in particular page 9, lines 30 to 32; page 11, lines 15 to 18); and
  - sending means responsive to the determining means for sending the determined trigger conditions to a mobile station (see in particular page 10, lines 14 to 35).

The subject-matter of respective claims 26 and 28 therefore is **not new**, Article 33 (2) PCT.

It should furthermore be noted that even if novelty of said respective claims 26 and 28 could be argued, based on minor differences between the features of respective claims 26 and 28 and those disclosed in document **D1**, the subject-matter of said claims would **not involve an inventive step**, Article 33 (3) PCT, having regard to the disclosure of document **D1** and the normal knowledge of a person skilled in the art of mobile communications systems and related measurement reporting technologies (see eg. also document **D2**, in particular column 6, lines 15 to 18; column 6, line 62 to column 7, line 2).

3. The same considerations as made in above paragraph 1 relating to lack of novelty and inventive step of claim 1 are also valid for **independent claim 29** since claim 29 is based essentially on the same principle as claim 1 in terms of a mobile sta-

tion.

The subject-matter of independent claim 29 therefore **is neither new**, Article 33 (2) PCT, **nor does it** involve an inventive step, Article 33 (3) PCT.

4. **Dependent claims 2 to 25, 27 and 30** do **not** appear to contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step for the reason that the subject-matter of said claims **either is in principle** directly derivable from the disclosure of document **D1** (see in particular page 1, line 5 to page 5, line 20; page 9, line 20 to page 11, line 18; Figures 1, 2 and 5) or document **D2** (see in particular column 4, lines 11 to 44; column 6, line 15 to column 7, line 2), **or** represents minor design details which are based on the general knowledge of the person skilled in the art of mobile communications systems and related measurement reporting technologies (see eg. the prior art acknowledged by the applicant himself in the present description on page 1, line 16 to page 4, line 26).

Dependent claims 2 to 25, 27 and 30 therefore **do not** meet the requirements of Article 33 (3) PCT.

**B. Remarks made in respect of paragraph VII:**

1. To meet the requirements of Rule 5.1 (a) (ii) PCT, the documents **D1** and **D2**, which represent a relevant state of the art with regard to the present invention, should have been identified in the opening part of the description and the relevant background art disclosed therein should have been briefly discussed.
2. To meet the requirements of Rule 6.3 (b) PCT, any independent claim should have been **correctly** cast in the **two-part form**, with those features which in combination are part of the nearest prior art (eg. document **D1**) being placed in the preamble.
3. **Reference signs** in parentheses should have been inserted in all the claims to increase their intelligibility, Rule 6.2 (b) PCT. This applies both to the preamble

and to the characterizing portion.

**C. Remarks made in respect of paragraph VIII:**

The following amendments would have been necessary to the **claims**:

1. It is clear from the description on page 1, line 35 to page 2, line 1, on page 17, line 30 to page 18, line 2 and on page 18, lines 27 to 28, that the following features are essential to the definition of the invention:

The method comprises the steps of defining **in the network** at least two independent measurement report triggering conditions, **sending said triggering conditions to the mobile station**, monitoring ...

Since **claim 1** does not contain these features it does not meet the requirement following from Article 6 PCT taken in combination with Rule 6.3(b) PCT that any independent claim must contain all the technical features essential to the definition of the invention.

It should however be noted that, even if these features were included in claim 1, claim 1 would not meet the requirements of Article 33 (2) and (3) PCT in respect of novelty and inventive step, having regard to the disclosure of document D1 (see for these features in particular page 9, lines 30 to 32; page 10, lines 14 to 35; page 11, lines 15 to 18).

2. Although **claims 26 and 28** have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought (ie. claim 26 relates to a telecommunication network and claim 28 relates to a network element for a telecommunication network); claims 26 and 28 include the same feature combination, ie. said claims are of **overlapping scope** and therefore **lack conciseness**.

Moreover, **lack of clarity** of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/FI99/00096

which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

Hence, claims 26 and 28 do **not** meet the requirements of Article 6 PCT. In order to overcome this objection, it would appear appropriate to file an amended set of claims defining the relevant subject-matter in terms of a **single** independent claim relating either to the telecommunication network or to the network element.

3. The wording of respective **claims 7 and 8** should be: "A method according to claim 6, **characterized in that** the network uses a CDMA air interface ..." (Article 6 PCT).

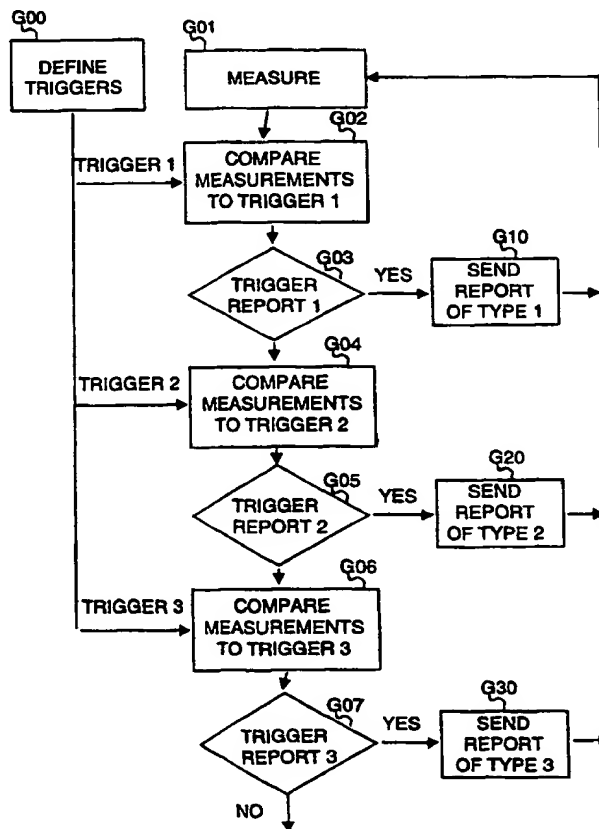


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>H04Q 7/38</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/43178</b> <b>(43) International Publication Date:</b> 26 August 1999 (26.08.99)
<b>(21) International Application Number:</b> PCT/FI99/00096 <b>(22) International Filing Date:</b> 9 February 1999 (09.02.99) <b>(30) Priority Data:</b> 980357 17 February 1998 (17.02.98) FI <b>(71) Applicant (for all designated States except US):</b> NOKIA TELECOMMUNICATIONS OY [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> SALONAHO, Oscar [FI/FI]; Oksasenkatu 4 b A 8, FIN-00100 Helsinki (FI). SIPILÄ, Kari [FI/FI]; Hiirisuontie 11 B 2, FIN-01690 Vantaa (FI). <b>(74) Agent:</b> JOHANSSON, Folke; Nokia Corporation, P.O. Box 226, FIN-00045 Nokia Group (FI).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** MEASUREMENT REPORTING IN A TELECOMMUNICATION SYSTEM**(57) Abstract**

The basic idea of the present invention is to specify at least two different triggers for sending a measurement report from the mobile station to the network. According to the invention, the network specifies the triggers to be used in different measurement report types. The triggers are preferably upper or lower threshold values for parameters of the radio signal. In response to having detected that the measured value has exceeded its upper threshold value or gone under its lower threshold, the mobile station sends the network a measurement report.



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## Measurement reporting in a telecommunication system

### Field of the invention

This invention concerns reporting of measurements on radio interface in a telecommunication system.

### 5 Background of the invention

In mobile telecommunication systems mobile stations MS can use the services provided by the network using radio connections. The radio connection uses the channels of called radio interface between the mobile station and a base station of the mobile telecommunication network. Only a  
10 limited bandwidth on the radio spectrum is allocated to be used by the telecommunication systems. To gain capacity enough, the channels must be used again as densely as possible. To achieve this, the coverage area of the system is divided into cells, each being served by one base station. Due to this, the mobile telecommunication systems are often also called cellular  
15 systems.

The network elements and the internal relation between the network elements of a mobile telecommunication system are presented in Figure 1. The network presented in the figure is in accordance with the UMTS system currently being standardized by ETSI (European  
20 Telecommunications Standards Institute). The network comprises base stations BTS (Base Transceiver Station), that can establish connections with the mobile stations MS, Radio Network Controllers RNC controlling the usage of base stations and Mobile Switching Centers MSC controlling the RNC's. In addition, the network comprises a Network Management System  
25 NMS, with the help of which the operator can modify the parameters of the other network elements. The interface between the MSC and the RNC's is generally called the Iu interface. The interface between the RNC's and the BTS's is the Iubis interface and the interface between the BTS and the MS's is the radio interface. According to some proposals, an interface Iur between  
30 the RNC's is specified.

The calls of a mobile station are routed from the BTS via the RNC to the MSC. MSC switches the calls to other mobile switching centers or to

the fixed network. The calls can as well be routed to another mobile station under the same MSC, or possibly even under the same BTS.

The radio interface between the base stations and the mobile stations may be divided into channels using a plurality of divisions. Known methods of division are, for example, Time Division Multiplexing TDM, Frequency Division Multiplexing FDM and Code Division Multiplex CDM. In TDM systems, the spectrum allocated for the system is divided into successive time frames consisting of time slots, each time slot defining one channel. In FDM the channel is defined by the frequency used in the connection. In CDM the channel is defined by the spreading code used in the connection. These methods can be used separately or be combined.

To be able to successfully communicate with the mobile telecommunications network, the mobile station continuously monitors the radio signals sent by the base stations. In the idle mode the mobiles decode the strongest signal received, and when needed request the establishment of a connection from the base station transmitting this signal.

During an active connection, the connection can be moved from one base station to another. The connection can be moved from one base station to another by simply rerouting the signal, which is called hard handover. The system interference can be decreased and thus the capacity increased especially in CDMA (Code Division Multiple Access) systems utilizing CDM by using soft handovers in which the mobile has simultaneously connections with a plurality of base stations, these base stations forming the so called active set of the connection.

The handover may be

- intra-cell handovers
- inter-cell handovers between two base stations under the same radio network controller
- inter-RNC handovers between two RNC's under the same MSC, or
- inter MSC handover between two cells under different MSC's.

In addition, the handover can be divided into intra-frequency handovers in which all the channels involved in the handover procedure are on the same frequency and inter-frequency handovers, in which there are channels from at least two frequencies involved in the handover procedure.

To be able to establish the handovers to right base stations during an active connection, the mobile station continuously measures the radio

signals from the base stations it is in connection with as well as their neighboring base stations. The measurement results are transmitted to the network using the measurement reporting scheme specified in the system. Based on the reports, the network initiates the handover when the mobile station would have a better or at least sufficiently good radio connection to another base station.

In addition to the network initiated handovers, also mobile evaluated handovers are known. In an exemplary description of a mobile evaluated handover, the mobile station monitors the signal levels received from neighboring base stations and reports to the network those beacon signals which are above or below a given set of thresholds. Those thresholds can be dynamically adjusted as will be explained in the following. Based on this reporting scheme, the network will decide whether the active set of the connection is to be changed.

Two type of thresholds are used: the first one to report beacons with sufficient power to be used for coherent demodulation, and the second one to report beacons whose power has declined to a level where it is not beneficial to be used for receiving the sent information. Based on this information, the network orders the MS to add or remove base station signals from its active set.

While soft handover improves overall performance it may in some situations negatively impact system capacity and network resources. This is due to the unnecessary branches between the MS and the base stations in the active set. On the downlink direction from the base stations to the mobile station, excessive branch reduces system capacity while on the uplink direction from the mobile station to the base stations, it costs more network resources.

To solve this problem, the principle of dynamic thresholds for active set management is known in prior art. In this method, the MS detects beacons crossing a given static threshold T1. When crossing this threshold the beacon is moved to a candidate set. It is then searched more frequently and tested against a second dynamic threshold T2. This second threshold T2 will test if the beacon is worth adding to the active set.

When the beacons corresponding to the branches in the active set are weak, adding an additional branch signal, even a poor one, will improve performance. In these situations, a relatively low value of T2 is used. When there is one or more dominant beacons, adding an additional weaker branch

whose beacon signal is above T1 will not improve performance but will utilize more network resources. In these situations a higher value of T2 is used.

After detecting a base station signal above T2, the MS will report it back to the network. The network will then set up the handover resources and order the MS to coherently demodulate the signal of this additional branch.

Beacons can be dropped from the active set according to the same principles. When the beacon strength decreases below a dynamic threshold T3, the handover connection is removed, and the beacon is moved back to the candidate set. The threshold T3 is a function of the total energy of beacons in the active set. When beacons in the active set are weak, removal a branch, even a weak one, will decrease performance. In these situations, a relatively low value of T3 is used. When there is one or more dominant branches, removal of a weaker signal will not decrease performance but will make the utilization of the network resources more efficient. In these situations a higher value of T3 is used. Branches not contributing sufficiently to the total received energy will be dropped. When further decreasing below a static threshold T4 a beacon is removed from the candidate set.

To be able to control the connection, the network needs in different situations different kinds and different amount of measurement information. The more information is sent the more efficient the handover algorithm are. However, the more information the mobile station sends the network, the more radio resources are spent. Thus, the measurement reporting schemes according to prior art are always compromises between the efficiency of the handover algorithms and the usage of radio resources.

As the usage of mobile telecommunication systems and multimedia applications requiring large bandwidths is growing the present methods are no longer sufficient, thus limiting the performance of the mobile telecommunication networks. The objective of the present invention is a flexible measurement reporting scheme which solves this problem.

### Summary of the invention

The basic idea of the present invention is to specify at least two different triggers for sending a measurement report from the mobile station to the network. According to the invention, the network specifies the triggers to

be used for different measurement report types. The triggers are preferably upper or lower threshold values for parameters of the radio signal, timer conditions, etc. In response to having detected that the measured value has exceeded its upper threshold value or gone under its lower threshold, the  
5 mobile station sends the network a measurement report.

According to a preferred embodiment, one or a plurality of the triggers can be inactivated by the network. However, at least one trigger must always be active.

According to one preferred embodiment, the triggers, i.e. the  
10 threshold values are defined separately for downlink and uplink directions. In addition, it is specified how the outputs of these triggers are to be combined. For example, it may be determined whether the measurement report is to be sent when both the uplink and downlink conditions are met, when either of them is met, based entirely on the downlink condition or based entirely on  
15 the uplink condition.

In one preferred embodiment, one of the measurement report types is mobile evaluated handover measurement report. Such a report is triggered in the mobile station when at least one upper threshold for the radio signal parameter for a mobile evaluated handover is exceeded or lower  
20 threshold gone under.

According to another preferred embodiment, one of the measurement report types is periodic handover measurement report. Such a report is triggered periodically with a period set by the network.

According to yet another embodiment, one of the measurement  
25 report types is a condition change based measurement report. In this report type, the transmission of the measurement report is triggered by a change in the radio signal parameter exceeding a threshold given by the network.

### **Brief description of the figures**

The invention is described more closely with reference to the  
30 accompanying schematic drawings, in which

Figure 1 shows a mobile telecommunication system;

Figure 2 shows a measurement reporting scheme;

Figure 3 shows the structure of a MEHO algorithm;

Figures 4, 5, 6, 7 and 8

35 each show a decision flow chart;



Figure 9 shows functional entities in a telecommunication network, and Figure 10 shows functional entities in a mobile station.

### Detailed description of the invention

The basic idea of the invention is presented schematically in Figure 2. In stage G00, a plurality of triggers is defined in the network. In the exemplary embodiment presented in the figure, three triggers, TRIGGER 1, TRIGGER 2 and TRIGGER 3 are defined. However, it must be noted here that the invention is not limited to the use of exactly three triggers, but the number of triggers may be any number equal to or larger than two. The mobile station is informed about these triggers.

The mobile station continuously measures the radio signals from the base stations in the neighborhood (stage G01). In these measurements, the mobile acquires information necessary to compare the measurement results to the triggers.

At stage G02 the measurement results are compared to TRIGGER 1. If the conditions launching the trigger are met (decision stage G03), a measurement report of type 1 is sent to the network at stage G10, and the procedure continues to stage G01. If the conditions are not met, the procedure continues to stage G04.

At stage G04 the measurement results are compared to TRIGGER 2. If the conditions launching the trigger are met (decision stage G04), a measurement report of type 2 is sent to the network at stage G20, and the procedure continues to stage G01. If the conditions are not met, the procedure continues to stage G06.

At stage G06 the measurement results are compared to TRIGGER 3. If the conditions launching the trigger are met (decision stage G07), a measurement report of type 3 is sent to the network at stage G30. The procedure then continues to stage G01.

According to a preferred embodiment, one or a plurality of the triggers can be inactivated by the network. Thus, the network is capable of flexibly adjusting the reporting scheme. For example, when in the inner parts of a cell, the mobile station has a very good link with the base station. In such a situation, it is adequate that the mobile station informs the network, when the link gets worse than a given threshold. In this situation, only one of the trigger conditions is active. When the mobile station reaches the border

region of the cell, this threshold condition is met, and the mobile station sends the network a measurement report. Upon receiving this report, the network decides, that the mobile station should be followed more closely, and orders the mobile station to start sending the measurement reports periodically and at once when the links monitor meet a second threshold condition. Now, two trigger conditions are active. In all situations, however, at least one trigger condition must be active.

In Figure 2, the comparisons at stages G02, G04 and G06 are shown to be serial. However, they may as well be implemented as parallel processes.

In the following, three preferred types of measurement reports are specified more closely. The types are particularly preferred when using a Wideband CDMA (WCDMA) system utilising soft handovers. The report types are Mobile Evaluated HandOver (MEHO), periodic measurement reporting and condition change based measurement reporting.

#### **The mobile evaluated handover**

In this context mobile evaluated handover means, that a handover measurement algorithm situated in the mobile triggers the handover report. The actual HO decision is always performed by the network. The handover report types can be further divided into intra-frequency and inter-frequency handover report types.

#### **The intra-frequency handover**

The algorithm presented in the following includes the possibility to use information about the downlink (DL),uplink (UL) or both as the trigger for the HO report. Also this scheme provides a flexible means to control the information content of the HO report. The actual thresholds and timers in the algorithm are selected to be such, that a wide variety of HO algorithms can be constructed by the appropriate setting of these

The mobile station continuously performs measurements on the radio signals from different BTS's according to the procedure described in the following.

The mobile measures the received power of the beacon channel for BTS<sub>i</sub>. This power is denoted as  $P_{rx,i}$  (mW). The MS performs this measurement for time period  $t$  (a parameter preferably set by the network).

The value of  $P_{rx,i}$  is averaged over the measurement period. The result of this operation is denoted as  $P_{ave_{rx,i}}$ . When the measurement is completed, the path loss estimate, denoted as  $L_i$  (dB), is calculated as:

$$L_i = -10 \log_{10} \left( \frac{P_{ave_{rx,i}}}{P_{beacon_{tx,i}}} \right) \quad (1)$$

In (1), the unit of  $P_{beacon_{tx,i}}$  is mW.

During the same measurement period  $t$  the MS also estimates the interference power of the beacon channel before or after (this is preferably a parameter defined by the network) correlating the received sum signal with the spreading code. The values calculated before or after the correlation differ due to the fact that the correlation remarkably reduces the interference caused by other connections. This interference is denoted as  $I_i$  (mW). The interference is also averaged over the measurement period. After the averaging has been performed, the average value is converted into dBm. This average is denoted as  $I_{ave,i}$ .

The MS is also to receive, e.g. on the beacon channel the  $DL\_offset$  value of  $BTS_i$ , denoted as  $DL\_offset_i$  (dB), which is a relatively stable parameter and there is thus no need to re-receive it for each measurement period. The purpose of this base station specific parameter is to specify for different cell sizes. The mobiles are handed over from a first set of cells more willingly than from a second set of cells. These cells of the first set thus become smaller than the cells of the other set. The offset value can be seen as an additional base station specific part of the threshold values that are soon to be presented more closely.

From the above information the MS is to calculate one DL HO measurement  $S_{dl,i}$  sample as

$$S_{dl,i} = L_i + I_{ave,i} + DL\_offset_i \quad (2)$$

30

$S_{dl,i}$  is thus a measure for the carrier to interference ratio CIR of the measured signal. It is to be noted that the larger the value of  $S_{dl,i}$ , the worse the link from the base station to the mobile station is. The scope of this invention is not limited to the use of this particular measure, but other measures of the link quality may as well be used when implementing the

35

present invention. As one example, the bit error ratio BER in the received radio signal can be used as the measure.

The MS is also to receive, e.g. on the beacon channel, the total interference power,  $I_{ul,i}$  (dBm) at the  $BTS_i$  and the UL offset value,  $UL\_offset_i$  (dB) of  $BTS_i$ . The MS is then to calculate the value of one UL HO measurement sample as

$$S_{ul,i} = L_i + I_{ul,i} + UL\_offset_i \quad (3)$$

When these measurements and calculations have been performed for  $BTS_i$  the MS is then to place the results as the first elements in the vectors  $L\_vect_i$  (for the value of  $L_i$ ),  $S\_vect_{dl,i}$  (for the value of  $S_{dl,i}$ ) and  $S\_vect_{ul,i}$  (for the value of  $S_{ul,i}$ ). The last element of these vectors is discarded. The vectors comprise the history of the measurement results. The length of the history maintained, defined by the length  $n$  of these vectors is a network parameter.

Having performed the measurements for this base station signal the MS checks whether a MEHO report is to be transmitted according to the HO algorithm described in the following chapter. The argument of the algorithm may be for instance either median or mean of the vectors  $S\_vect_{dl,i}$  and  $S\_vect_{ul,i}$ , and is preferable defined by the network. In addition, the MS starts to measure the beacon signal transmitted by the next BTS  $BTS_{i+1}$ .

The HO algorithm is used to trigger the transmission of the MEHO measurement report. In the algorithm the UL and DL directions of transmission are treated separately. So actually two algorithms can function in the MS independently. The network can command the MS to use either one of them or both for the triggering of measurement report transmission. It should be noted, however, that the active set is always the same for both directions of transfer.

The algorithm includes the below thresholds:

1. Branch addition threshold denoted in this document as  $BA\_abs_{th}$  and  $BA\_rel_{th}$ ,
2. Branch deletion threshold denoted in this document as  $BD\_abs_{th}$  and  $BD\_rel_{th}$ , and
3. Branch replacement threshold denoted in this document as  $BR\_rel_{th}$

For the thresholds 1 and 2, both an absolute and a relative threshold are defined. Separate values can be defined for the uplink and the downlink directions. The thresholds are used in Branch Addition (BA), the Branch Deletion (BD) and the Branch Replacement (BR) decision units.

5 These units may be implemented as hardware units, software blocks or a combination of these.

The basic structure of these algorithms is presented in Figure 3. The uplink comparison unit ULU compares the measurement results of the uplink radio signals to triggers defined by the thresholds set to these signals, and outputs a logical truth value. The downlink comparison unit DLU compares the measurement results of the downlink radio signals to triggers defined by the thresholds set to these signals, and outputs a logical truth value. The results of ULU and DLU are combined to one logical signal using a logical function. The logical value may be, for example, AND or OR

10 function, or a function outputting directly one of the input values of the block. The truth value of this signal is verified, and a report is sent if the truth value is TRUE, for example. Of course, using a different logical function when combining the outputs of ULU and DLU, it can be defined that the report is sent if the truth value is FALSE.

20 The parallel decision units BA, BD and BR shown in Figure 3 are used in different situations. BA is used when the base station is not in the active set of the connection, and the number of links between the MS and BTS's in the active set is less than a given limit  $N_{AS,max}$ . The value of  $N_{AS,max}$  is a preferably a parameter set by the network.

25 BD is used when the base station is in the active set of the connection. To prevent ping-pong effect, the logical functions of the BA and BD blocks must be consistent so that the same measurement values for a link between the MS and a BTS may not cause both the units to trigger a measurement report suggesting an addition or deletion of the same link. For

30 example, if logical functions AND and OR are used, the value OR may not be used in both the decision blocks.

BR is used when the base station is not in the active set of the connection and the number of links between the MS and BTS's in the active set is equal to the limit  $N_{AS,max}$ . This decision unit is used to replace on link of

35 the active set by another one having better radio characteristics.

One algorithmic implementation of the downlink comparison unit DLU of the branch addition algorithm BA is shown in Figure 4. The algorithm

is used for beacon signals from base stations that do not belong to the active set. At stage A1 it is checked whether the number of base stations in the active set is less than a predefined limit, i.e. whether the active set is full. As an example, the limit 3 can be used here. If the active set is full, the branch replacement algorithm is selected instead of this algorithm (stage A10).

If the active set is not full the procedure proceeds to stage A2, A3 and A4, in which

- it is checked whether new measurement results have been received (stage A2),
- $S_{i,DL}$  is compared to absolute threshold  $BA_{abs_{th,DL}}$ , and
- $S_{i,DL}$  is compared to threshold  $S_{best_{i,DL}} + BA_{rel_{th,DL}}$ , in which  $S_{best_{i,DL}}$  is the value measured for the best active branch.

If new results have been received and both the threshold values  $BA_{abs_{th,DL}}$  and  $S_{best_{i,DL}} + BA_{rel_{th,DL}}$  are higher than  $S_{i,DL}$ , the output of the DLU is set to TRUE.

The uplink branch can be implemented using a similar algorithm. If new results for the uplink have been received and both the threshold values  $BA_{abs_{th,UL}}$  and  $S_{best_{i,UL}} - BA_{rel_{th,UL}}$  are higher than  $S_{i,UL}$ , the output of the ULU is set to TRUE. The threshold values  $BA_{abs_{th,DL}} / BA_{abs_{th,UL}}$  and  $BA_{rel_{th,DL}} / BA_{rel_{th,UL}}$  used in different directions may be different from each other or identical.

The values of the DLU and ULU algorithms are inputted into the logical function, as shown in Figure 3. MEHO measurement report is sent if the function outputs a value TRUE. For example, if the logical value used is AND, the MEHO measurement report is sent when both the ULU and DLU have value TRUE.

An algorithmic implementation of the downlink comparison unit DLU of the branch deletion algorithm BD is shown in Figure 5. This algorithm is used for beacon signals from base stations that belong to the active set.

It is first checked whether new measurement results have been received (stage D2). The measurement result  $S_{i,DL}$  is compared to thresholds  $BD_{abs_{th,UL}}$  (stage D3) and  $S_{best_{i,DL}} + BD_{rel_{th,UL}}$  (stage D4). If either of these thresholds is lower than  $S_{i,DL}$ , the DLU is set to TRUE (stage D5). Otherwise, DLU is set to FALSE (stage D10) and the next beacon signal in the active set is measured.

A similar comparison is made between the uplink measurement results and uplink thresholds to define the value of ULU. DLU and ULU are

combined using a logical function defined by the network to make a decision whether to send or not to send a MEHO measurement report. To prevent the ping-pong effect, the logical function used is selected so that the same measurement results never cause the BA to request the addition of a branch and the BD to delete the same branch. To meet this requirement, only one of the logical functions used in BA and BD algorithms according to the same reporting option may be a logical OR function.

5 An algorithmic implementation of the downlink comparison unit DLU of the branch replacement algorithm BR is shown in Figure 6. The algorithm is used for beacon signals from base stations that do not belong to the active set. At stage R1 it is checked whether the number of base stations in the active set is equal a predefined limit, i.e. whether the active set is full. As an example, the limit 3 can be used here. If the active set is not full, the branch addition algorithm is selected instead of this algorithm (stage R10).

15 If the active set is full the procedure proceeds to stage in which it is checked whether new measurement results have been received (stage R2). If no new measurement results have been received, the next beacon signal is studied. If new measurement result  $S_{i,DL}$  has been received it is compared at stage R3 to the measurement value  $S_{\_worst_{i,DL}}$  of the worst link in the active set. If  $S_{\_worst_{i,DL}}$  exceeds  $S_{i,DL}$  with a margin of  $BR\_rel_{th}$  DLU is set to TRUE (stage R4). Otherwise ULU is set to FALSE (stage R20) and the measurements on a next BTS not belonging to the active set studied.

The uplink branch can be implemented using a similar algorithm. In this comparison,  $S_{i,UL}$  is compared to  $S_{\_worst_{i,DL}}$  of the worst link in the active set. If  $S_{i,DL}$  exceeds  $S_{\_worst_{i,DL}}$  with a margin of  $BR\_rel_{th}$  DLU is set to TRUE. The margin values  $BR\_rel_{th}$  are preferably identical in downlink and uplink directions, but also different values in different directions can be used. This is a parameter that is defined by the network. DLU and ULU are combined using a logical function to make a decision whether to send or not to send an MEHO measurement report. The logical function is preferably a logical AND function. In another preferred embodiment, the logical function can be adjusted freely by the network. The output of the logical function can be, e.g. the truth value of DLU or ULU.

35 When the MEHO algorithms in the mobile station trigger the measurement report the status of the M best cells/sectors is transmitted. The transmitted measurement report is always to include the appropriate values

for the active set. The M best cells/sectors are determined by using the values of  $S_{i,dl}$  or  $S_{i,ul}$  depending on whether it was DL or UL algorithm that triggered the report. The contents of the report is preferably determined with an message sent from the network. The measurement report includes, for  
5 example the following values for each cell/sector to be reported. These values are the filtered values.

1.  $S_{i,dl}$
2.  $S_{i,ul}$
3.  $L_i$

10 It should be noted, that the measurement report can include information only about neighbour BTSs whose beacon signals have been decoded. Thus the handover report has to include the information of the number of BTSs that are being reported.

The information included in the measurement report may  
15 preferably be defined by the network. For example, the number of beacon signals whose power level is to be reported in a measurement report is preferably defined by the network.

### The Inter-frequency HO

The inter-frequency measurements are always initiated by the  
20 network. Thus the mobile can perform inter-frequency MEHO only after the network has first commanded the MS to start the inter-frequency HO measurements.

There are at least three different reasons for inter-frequency HO:

- 25 1. Coverage. The MS is e.g. exiting the coverage area of a microcell and has to hand over to a macrocell. This case may be relatively simple. For example if the branch deletion has triggered a measurement report and only one branch is active the conclusion by the network is, that the MS is exiting the coverage area. The network responds to this by transmitting a  
30 message 'start i-f measurements'. This message includes the possible candidate BTSs. The mobile would then start searching for a stronger BTS on the other frequency. The transmission of the measurement report is triggered when the MS finds a candidate BTS on the other ( new) frequency that is  
35 stronger than the best active branch on the current frequency.



2. Load. If for some reason the load on the used frequency is higher than on some other available frequency an inter-frequency HO may be appropriate. This situation would probably be known only by the network. After the network has detected the overload situation the actions are the same as in case 1

3. Mobile speed. The speed of the MS is so high, that an excessive amount of handovers are needed if the MS is connected to the microcell layer. This is an item for further study. The most crucial question is the detection of the MS speed. That is, there a method to reliably estimate the MS speed? Can the received beacon powers be measured often enough to be able to use fast fading based methods? What signalling does the MS use to indicate its' speed if the estimation is in the mobile?

After the MS has been commanded by the network to start the inter-frequency measurements the MS is to perform the measurements on the frequency given in the start measurement command.

The algorithm is used to trigger the transmission of the inter-frequency measurement report. In the algorithm the UL and DL directions of transmission are treated separately. So, actually two decision algorithms, DLU and ULU function in the MS independently. The outputs of these algorithms are combined as shown in Figure 3 to make the final decision concerning sending the measurement report. The network can command the MS to use either one of them or both for the triggering of measurement report transmission. It should however be noted, that the active set is always the same for both directions of transfer.

The algorithm includes the below threshold. For the threshold an absolute and a relative threshold  $CF_{abs_{th}}$  and  $CF_{rel_{th}}$  are defined. The decision flow chart for DLU unit of the algorithm is shown in Figure 7.

If new measurement results have been acquired in the new frequency not belonging to the active set, the link losses the beacon signal is suffering are compared to an absolute threshold  $CF_{abs_{th}}$ . If the quality of the link is sufficient it is compared to the best link in the active set. If the quality is better with a predetermined margin the output of the DLU algorithm is set to TRUE.

A similar algorithm ULU is run for downlink direction. The outputs of DLU and ULU are combined using a logical function as described earlier.

When the HO algorithms trigger the inter-frequency measurement report the status of the M best cells/sectors is transmitted. The M best  
5 cells/sectors are determined by using the values of  $S_{i,dl}$  or  $S_{i,ul}$  depending on whether it was DL or UL algorithm that triggered the report. The contents of the report is determined with a message sent from the network. The measurement report includes, e.g. the following values for each cell/sector to be reported. These values are the filtered values.

- 10
1.  $S_{i,dl}$
  2.  $S_{i,ul}$
  3.  $L_i$

It must be noted that the possible logical functions are not limited to those presented in the examples above. For instance, if the outputs of the  
15 DLU and ULU functions are not binary but have more levels or are even continuous functions triggered by some events on the radio signals in respective directions, fuzzy logical functions can be used when making the decision whether to send or not to send a measurement report based on the outputs of the functions DLU and ULU. The fuzzy logical functions are  
20 preferably given by the network.

### Periodic handover reporting

In a periodic measurement scheme the MS continuously performs measurements on the radio signals. The measurement report is to be transmitted periodically by the MS to the network. The transmission period is  
25 defined by the parameter  $T_{report}$  set by the network. It shall include the M best cells/sectors. The transmitted measurement report is always to include also the appropriate values for the active set. Whether the order of the sectors is set by  $S_{i,dl}$  or  $S_{i,ul}$  is set by the network.

The measurement report includes, e.g. the following filtered  
30 values for each cell/sector to be reported. These values are the filtered values.

1.  $S_{i,dl}$
2.  $S_{i,ul}$
3.  $L_i$

It should be noted that the measurement report can include information only about neighbour BTSs whose beacon signals have been decoded. Thus the handover report has to include the information of the number of BTSs that are being reported. The parameters defined by the network are preferably similar to those defined in the MEHO case presented above.

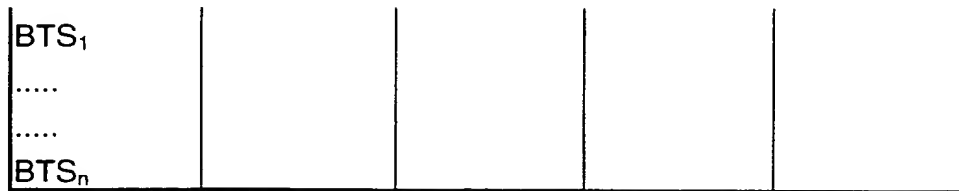
### Condition change based HO reporting scheme

The transmission of a condition change based measurement report is triggered if the conditions change by a sufficient amount. The amount of change needed is set by the network and denoted as  $\text{Change}_{th}$  (dB).

In this reporting scheme, the MS keeps a list of the  $N$  (a parameter preferably defined by the network) best BTSs. The order is determined by using either  $S_{i,ul}$  or  $S_{i,dl}$  (preferably an option set by network). When the value of  $S_{i,ul}$  or  $S_{i,dl}$  for one of these BTSs changes by  $\text{Change}_{th}$  a measurement report for including the new values of the changed quantities is transmitted. A measurement report is also transmitted if a new BTS appears, that is better than  $\text{Replace}_{th}$  ( dB) compared to the worst BTS (the value of  $S_{i,ul}$  or  $S_{i,dl}$  is used for this comparison depending on how the BTSs are placed in order) in the list . A measurement report can be at most transmitted every  $T$  ms ( this is a network parameter).

This method requires, that the MS keeps in memory in a table the values of the parameters transmitted in the previous measurement reports. That is, the MS has to keep in memory the situation as the network sees it based on the measurement reports transmitted by the MS. This table must include as its' elements the values of the quantities required (by the network) to be reported and the set of reported base stations, i.e. those base stations whose beacon signal measurements are reported. The format of this table, i.e. the  $\text{HO\_table}$  is thus for example the following:

	$S_{i,dl}$	$S_{i,ul}$	$L_i$	$P\_beacon_{tx,i}$
--	------------	------------	-------	--------------------



An implementation for the decision diagram for sending a condition change based measurement report is depicted in Figure 8. Having measured the signals (stage C1) and sent a measurement report (stage C2), the procedure waits for a delay T defined by the network (stage C3). At stage C4 the best signal of those beacon signals that do not belong to the set of reported base stations, i.e. the candidate base stations, is compared to the worst signal of those beacon signals that belong to the set of reported base stations. If the signal quality of the candidate base station exceeds that of the worst reported base station by a margin replace-th defined by the network, the worst base station is replaced by the candidate base station in the set of reported base stations (stage C10). The HO-table is updated (stage C11) and a measurement report transmitted (stage C12).

If there is no need to update the list of reported base stations, the changes in the measured signal values are compared to the given thresholds at stage C5. If the thresholds are not exceeded, the procedure returns to stage C4. If at least one of the thresholds is exceeded, a measurement report is generated (stage C11) and transmitted (stage C12).

The contents of the measurement report may be the same as the elements in HO\_table for the BTSs whose measurement value ( $S_{i,ul}$  or  $S_{i,dl}$ ) have changed. The measurement report/HO table can include, for example, the following filtered values for each cell/sector to be reported:

1.  $S_{i,dl}$
2.  $S_{i,ul}$
3.  $L_i$

The inter-frequency scheme for the condition change based reporting scheme is the same as the intra-frequency scheme except that the network commands the MS to initiate the measurements only when needed.

A network functionality's according to the invention are shown in Figure 9. The network comprises

- determining means for determining a plurality of independent trigger conditions

- sending means responsive to the determining means for sending the determined trigger conditions to a mobile station.

The sending means may send the threshold values to the corresponding mobile station using the Dedicated Control Channel DCCH associated with a traffic connection to the mobile station, for example. These means are preferably implemented in a single network element of the network, such as in the Radio Network Controller RNC.

In one preferred embodiment, one of the determining means determines thresholds for triggering the sending of a measurement report in the mobile station when at least one upper threshold for a mobile evaluated handover is exceeded or lower threshold gone under. An example of suitable parameters for such thresholds was given above.

In one preferred embodiment, one of the determining means determines trigger conditions for the transmission of a measurement report in the mobile station periodically. In this case, the determining means determine the suitable period for measurement reporting.

The determining means are preferably arranged to define the activity of respective trigger conditions, and the sending means are arranged to send this information to the mobile station.

According to yet another embodiment, one of the determining means determines thresholds for triggering the sending of a measurement report in the mobile station triggered by a change in the radio resources exceeding a threshold given by the network. An example of suitable parameters for such thresholds was given above.

A mobile station MS according to present invention is shown in Figure 10. The mobile station comprises

- receiving means for receiving from the network trigger conditions for the transmission of a measurement report,
- monitoring means for monitoring the radio signals,
- a plurality verifying means which is responsive to the receiving means and the monitoring means and which has the functionality of verifying whether the trigger conditions for sending a measurement report of a specified type are met,
- a plurality of report means responsive to the verifying means for establishing a measurement report, and
- sending means responsive to the report means for sending a measurement report to the network.

Preferably, the mobile station further has

- determining means (DLU, ULU) for verifying trigger conditions for uplink and downlink measurements separately to generate two different verification results and
- 5       • combining means responsive to the determining means for combining the verification results and to make the decision whether to send or not to send a measurement value, as shown in Figure 3.

10       The measurement reporting scheme according the invention provides flexible means for reporting measurement results. The advantage of the flexibility is that the measurement reporting can be adjusted to provide the network the necessary information while minimizing the amount of radio resources spent for the measurement reporting purposes.

15       The invention has been described above by means of preferred embodiments to illustrate the principles of the invention. As regards the details, the invention may vary within the scope of the attached claims. For example, the trigger condition for sending a measurement report may be a threshold for a linear combination of the downlink and uplink measurement results. In this case, the function defining the linear combination is preferably  
20       defined by the network.

## Claims

1. A method of measurement reporting in a telecommunication system comprising mobile stations and a network comprising base stations, wherein decisions upon establishing or canceling a link between a mobile station and a base station are made in the network on the basis of measurement reports sent from the mobile station to the network,  
5       **characterized** in that the method comprises the steps of  
      defining at least two independent measurement report triggering conditions,  
10       monitoring at the mobile station properties of a plurality of radio signals received from respective base stations,  
      generating a measurement report comprising information about the monitored radio signals at the mobile station when at least one of the triggering conditions is met, and  
15       transmitting the generated measurement report to the network.
2. A method according to claim 1 or 2, **characterized** in that the activity of at least one of the triggering conditions is defined by the network.
3. A method according to claim 1 or 2, **characterized** in that  
20       the method further comprises a step of resetting a timer in connection with the step of transmitting a measurement report, and  
      at least one of the trigger conditions comprises a condition for the value of the timer.
4. A method according to claim 1 or 2, **characterized** in that at least one of the trigger conditions is a threshold for a radio signal parameter or a function thereof.
- 25       5. A method according to claim 4, **characterized** in that the radio signal parameter is the received power level of the signal or a function thereof.
6. A method according to claim 4, **characterized** in that the radio  
30       signal parameter is the interference in the received radio signal or a function thereof.
7. A method according to claim 6 in a network using CDMA air interface in which the connections are separated using different spreading codes, **characterized** in that the value for the interference is an estimate for

the interference power made before the signal is correlated with the spreading code used in the connection.

8. A method according to claim 6 in a network using CDMA air interface in which the connections are separated using different spreading codes, **characterized** in that the value for the interference is an estimate for the interference power made after the signal has been correlated with the spreading code used in the connection.

9. A method according to any of claims 4 to 8, **characterized** in that the trigger condition comprises a base station specific offset value.

10. A method according to claim 9, **characterized** in that at least one of the offset values is dynamically defined by the network.

11. A method according to any of claims 4 to 8, **characterized** in that the trigger condition comprises a threshold for the change of a radio parameter or a function thereof.

12. A method according to any of claims 4 to 8, **characterized** in that

a first set of trigger conditions is defined for the radio signals in the uplink direction and a second set of trigger conditions is defined for the radio signals in the downlink direction,

a logical function is defined for combining the first and the second set of trigger conditions, and

at the mobile station, the state of each trigger condition is determined, the states combined using the logical function, and the measurement report is sent in dependence upon the condition of the logical function.

13. A method according to claim 12, **characterized** in that the first and second set of trigger conditions are dynamically defined by the network.

14. A method according to claim 12, **characterized** in that the logical function is defined by the network.

15. A method according to any of claims 12 to 14, **characterized** in that a first combination of the first and second sets of trigger conditions and the logical functions are defined to be used for radio signals from or to active base stations having an active link with the mobile station,

a second combination of the first and second sets of trigger conditions and the logical functions are defined to be used for radio signals from or to candidate base stations not having an active link with the mobile station,



and at the mobile station, the first combination is used for radio signals from or to active base stations and the second combination is used for radio signals from or to candidate base stations.

16. A method according to claim 15, and **comprising** the step of  
5 creating an active link between the mobile station and a candidate base station not having an active link with the mobile station when the network receives from the mobile station a measurement report triggered by that candidate base station.

17. A method according to claim 15, and comprising the step of  
10 deleting an active link between the mobile station and a base station when the network receives from the mobile station a measurement report triggered by that active base station.

18. A method according to any of the claims 15 to 17,  
15 **characterized** in that said two different logical functions are such that when a base station is in the active set, a measurement report is not triggered by a radio signal of that base station for the same set of radio properties as would trigger the transmission of a measurement report when the base station is in the candidate set.

19. A method according to any one of the claims 12 to 18  
20 **characterized** in that the method comprises a step of defining a logical function for use when the number of base stations in the active set is equal to a predefined maximum number, and defining the first and second sets of trigger conditions on the basis of the radio signal properties of the active base station having the worst signal conditions, and wherein a measurement  
25 report is triggered by a radio signal of a candidate base station causes that worst base station to be replaced by the candidate base station.

20. A method according to claim 19, **characterized** in that the maximum number is dynamically defined by the network.

21. A method according to claim 1 or 2, **characterized** in that the  
30 network informs the mobile station what information to include in the measurement report, and the mobile station includes this information in the measurement report.

22. A method according to claim 22, **characterized** in that the  
35 radio signals are ordered using a predefined condition, and in the measurement report sent from the mobile station, information about the properties of a predefined number of the best radio signals according to the condition are reported.

23. A method according to claim 21, **characterized** in that the number of radio signals to be reported is given by the network.

24. A method according to claim 21, **characterized** in that the measurement report comprises a value for the path loss for a reported signal  
5 or a function thereof.

25. A method according to claim 21, **characterized** in that the measurement report comprises a value for the carrier to interference ratio of a reported signal or a function thereof.

26. A telecommunication network for a telecommunication system  
10 comprising mobile stations and a network comprising base stations, in which system the mobile stations monitor radio signals sent by the base stations, **characterized** in that the network comprises

a determining means for determining a plurality of independent trigger conditions for triggering the transmission of a measurement report  
15 from the mobile station and

sending means responsive to the determining means for sending the determined trigger conditions to a mobile station.

27. A telecommunications network according to claim 26, **characterized** in that the determining means are further arranged to define  
20 the activity of respective trigger conditions, and the sending means are arranged to send information about the activity state to the mobile station.

28. A network element for a telecommunication network for a telecommunication system comprising mobile stations and a network comprising base stations, in which system the mobile stations monitor the  
25 radio signals sent by base stations, **characterized** in that the network element comprises

a determining means for determining a plurality of independent trigger conditions for triggering the transmission of a measurement report from the mobile station and

30 sending means responsive to the determining means for sending the determined trigger conditions to a mobile station.

29. A mobile station for a telecommunication system comprising mobile stations and a network comprising base stations, and the mobile stations monitor radio signals sent by the base stations, **characterized** in  
35 that the mobile station has

receiving means for receiving trigger conditions from the network for triggering the transmission of a measurement report,

monitoring means for monitoring the radio signals,

a plurality verifying means which is responsive to the receiving means and for the monitoring means and which has the functionality of verifying whether the trigger conditions for sending a measurement report of

5 a specified type are met,

a plurality of report means responsive to the verifying means for establishing a measurement report, and

sending means responsive to the report means for sending a measurement report to the network.

10 30. A mobile station according to claim 29, **characterized** in that the receiving means are arranged to receive at least first and second different set of trigger conditions for uplink and downlink signals, and a logical function for combining these sets of trigger conditions,

15 the verifying means are arranged to determine the states of each trigger condition and to combine the states according to the logical function, and

the report means are arranged to establish a measurement report to be sent by the sending means in dependence upon the condition of the logical function.

20

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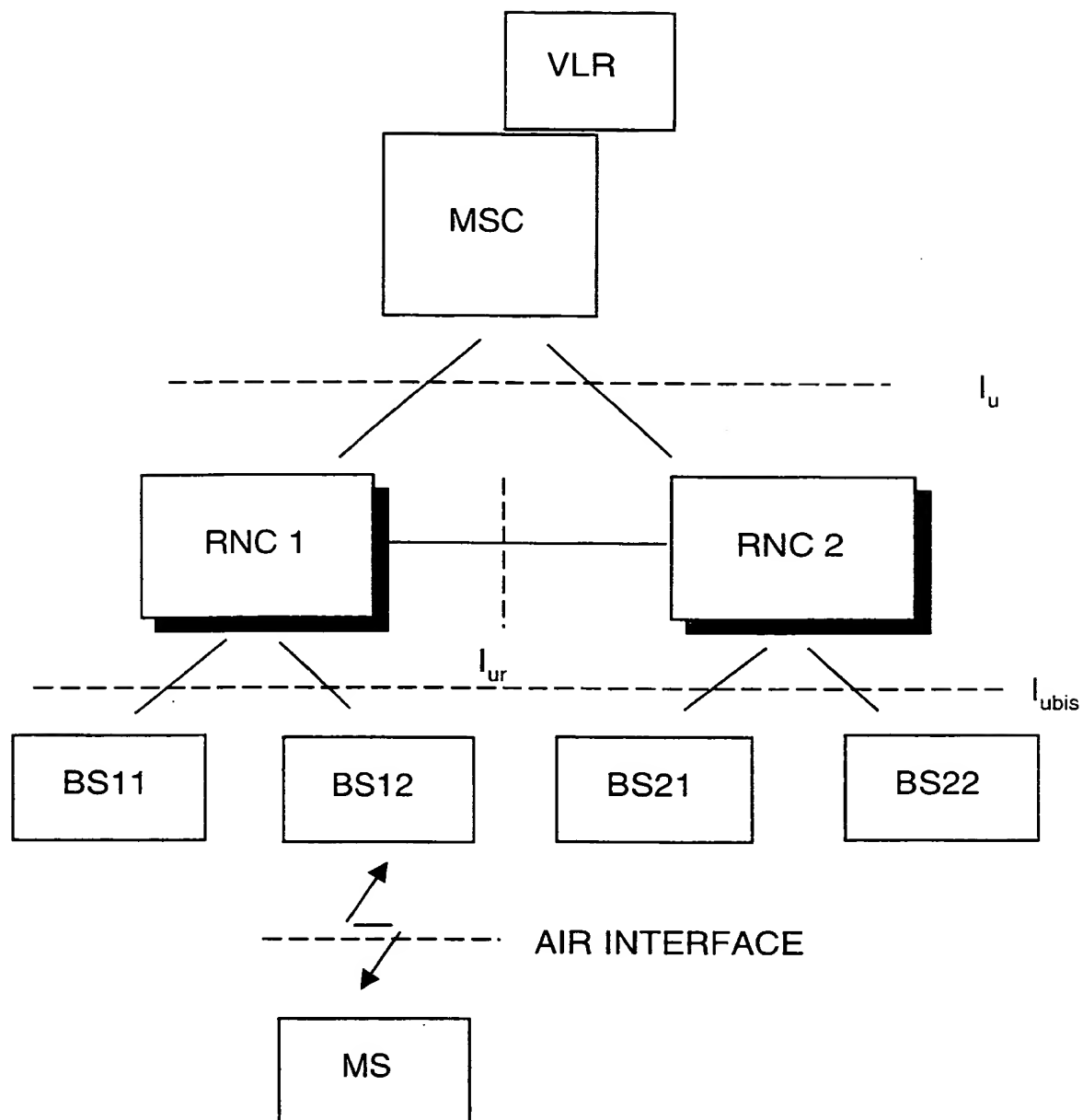


FIG. 1

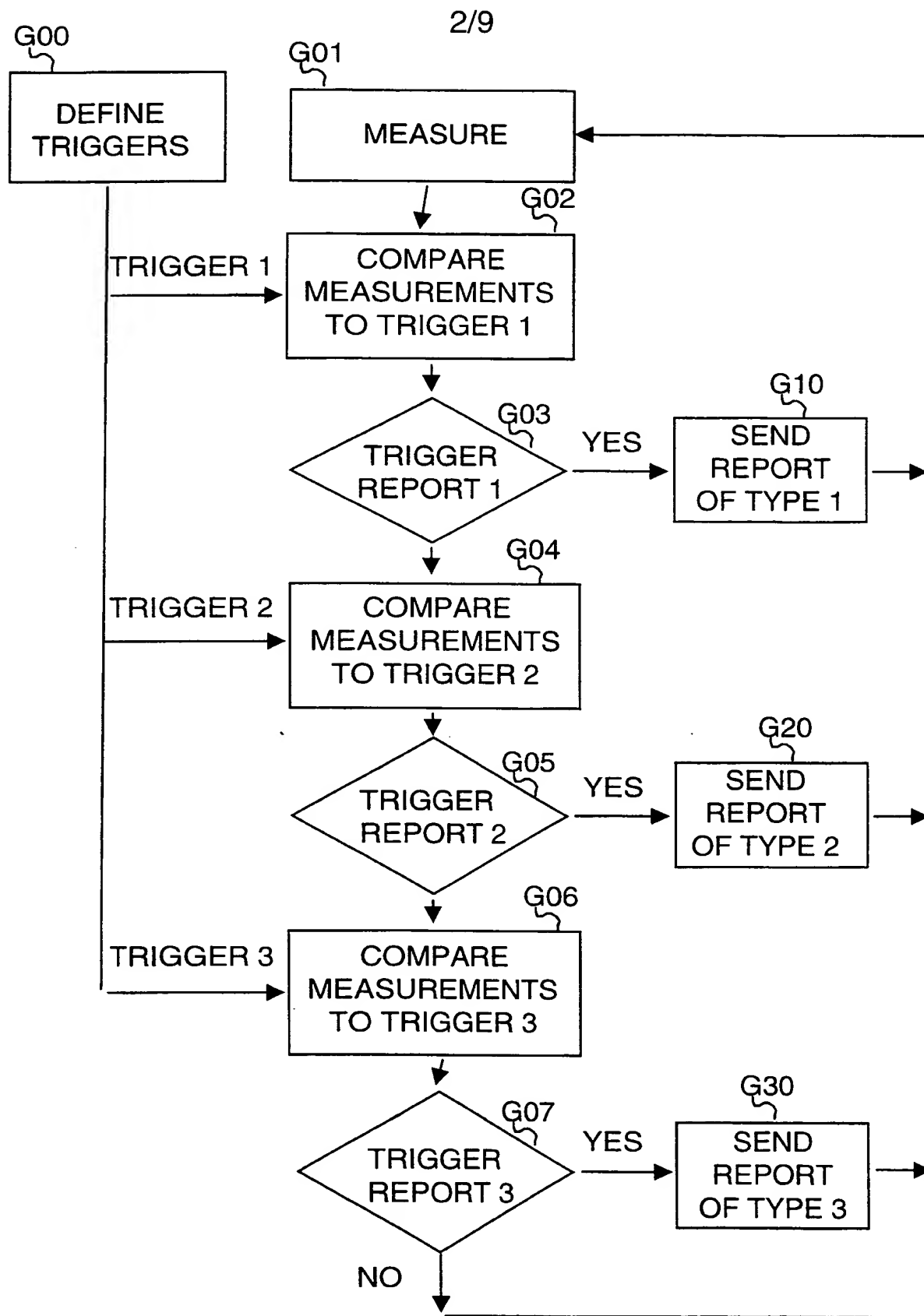


FIG. 2

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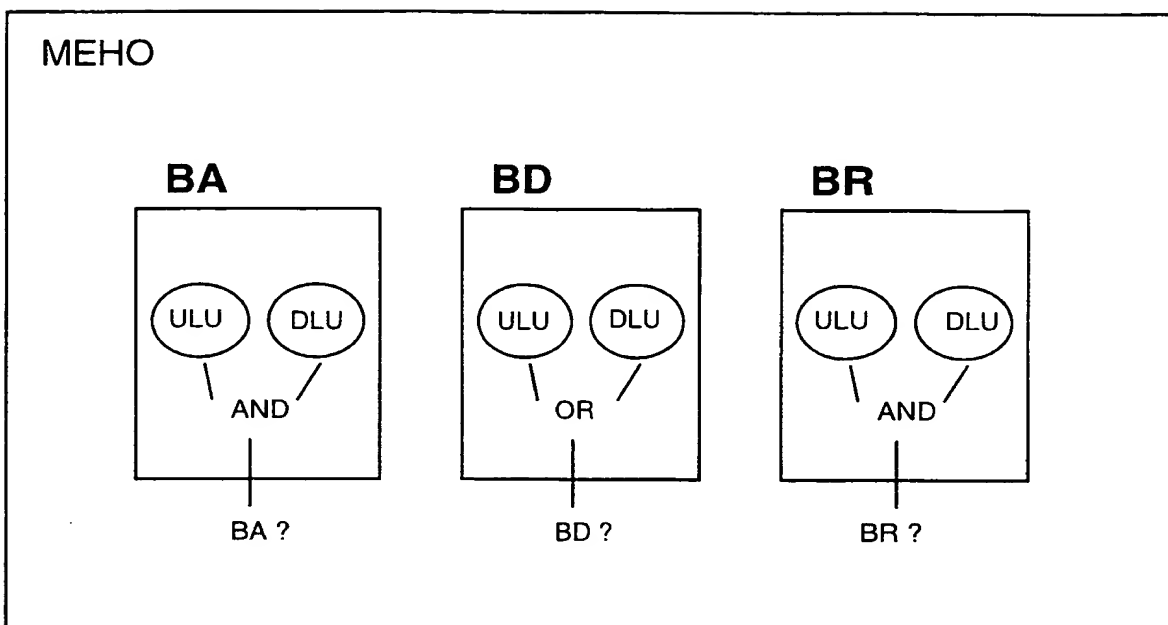


FIG. 3

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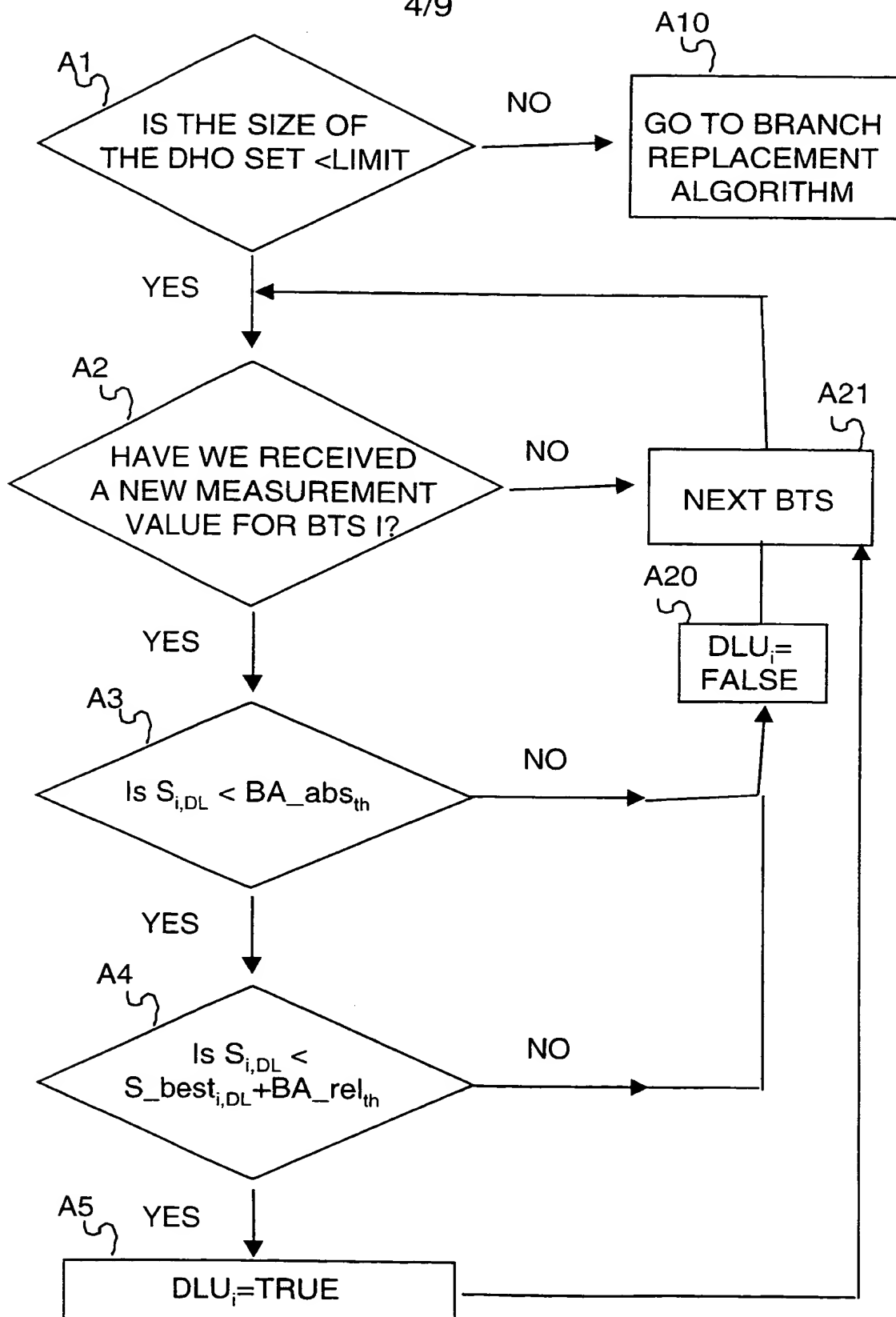


FIG. 4

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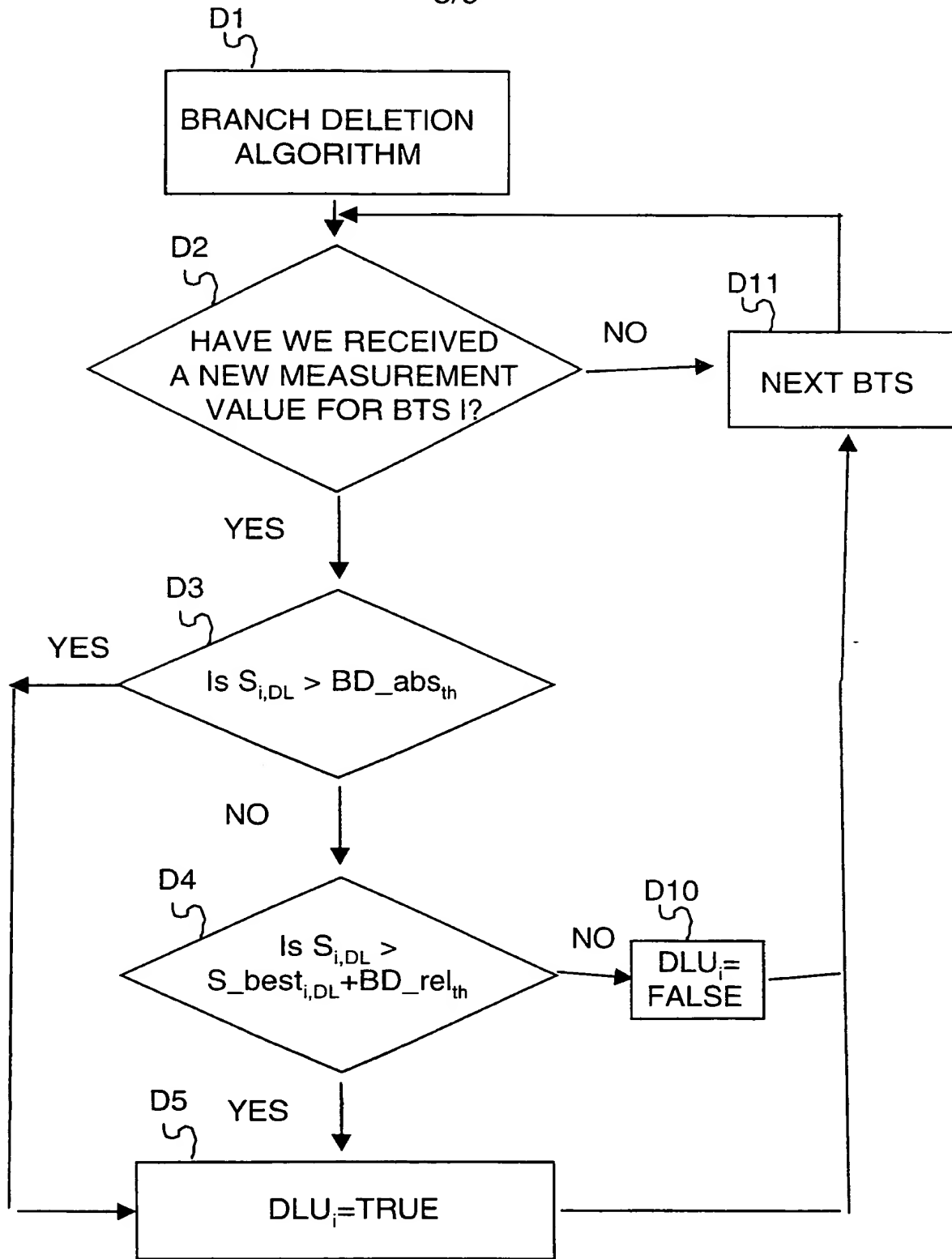


FIG. 5



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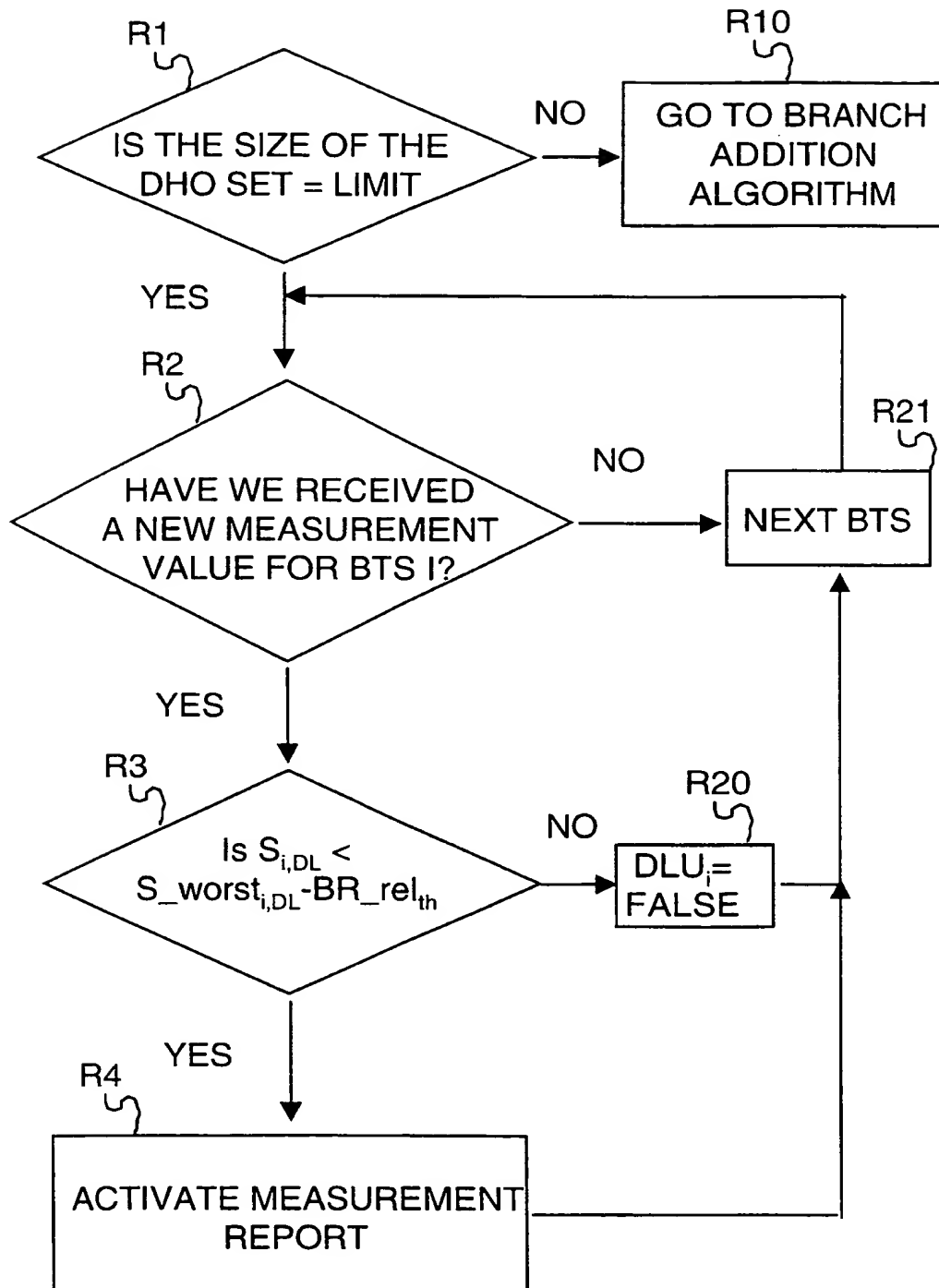


FIG. 6

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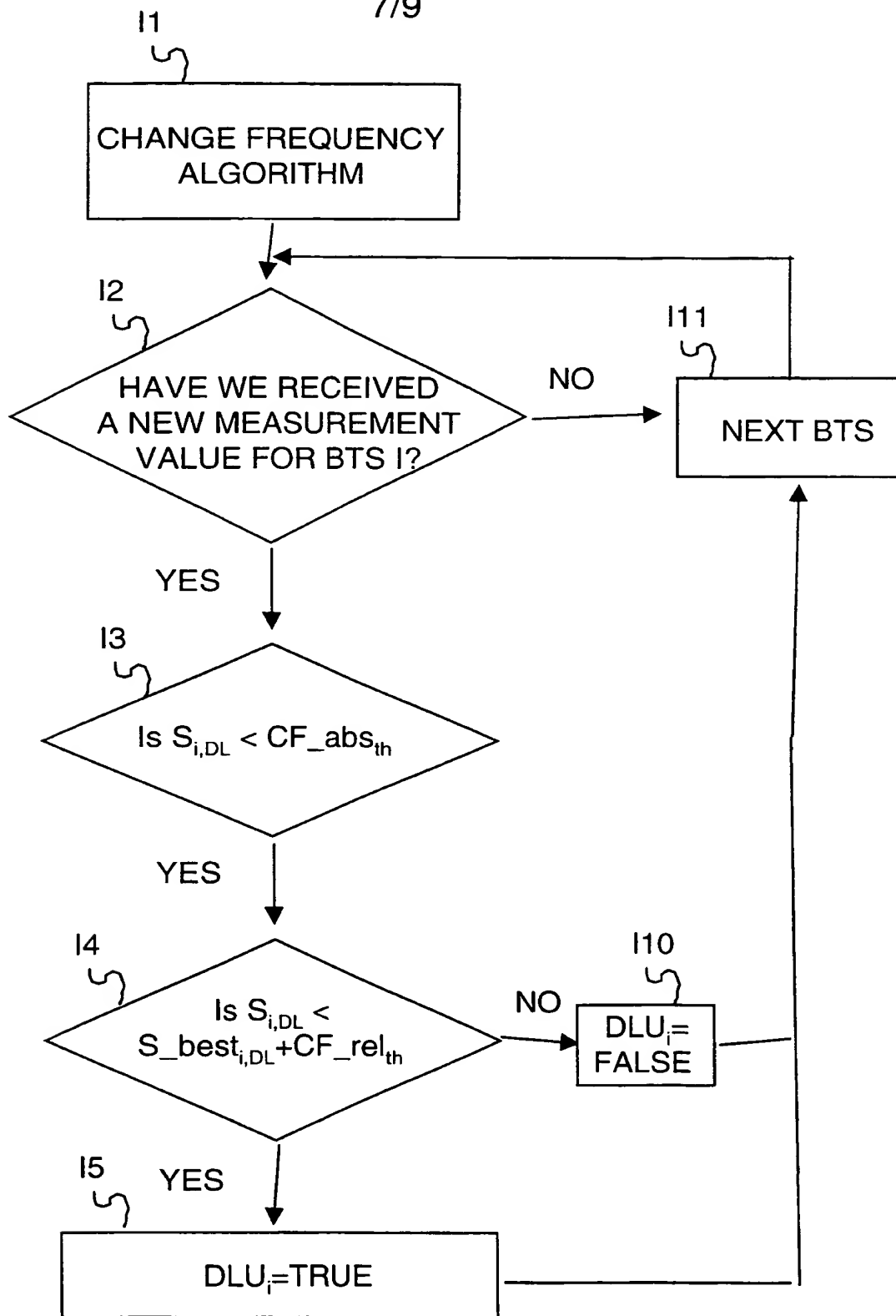


FIG. 7

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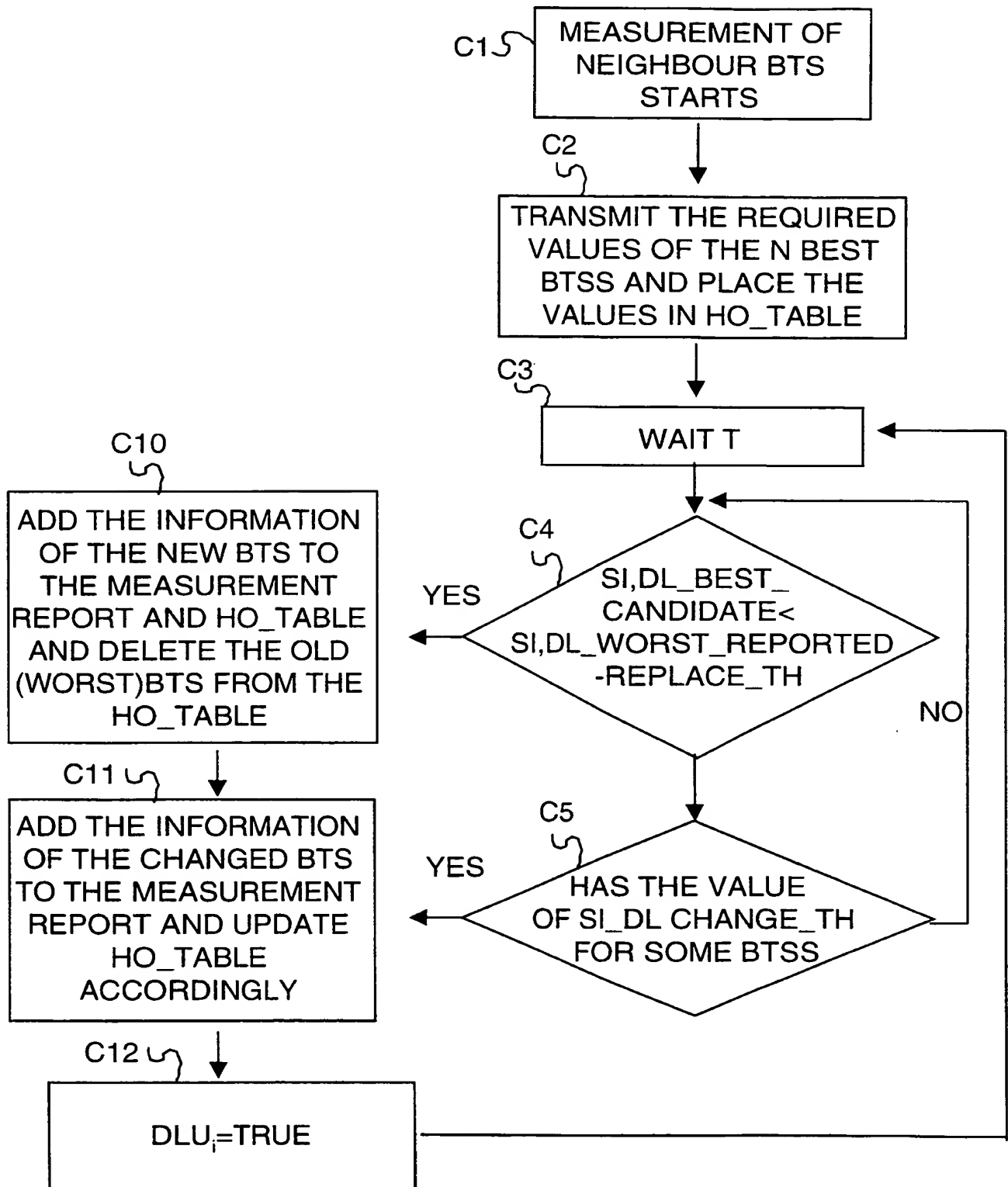


FIG. 8

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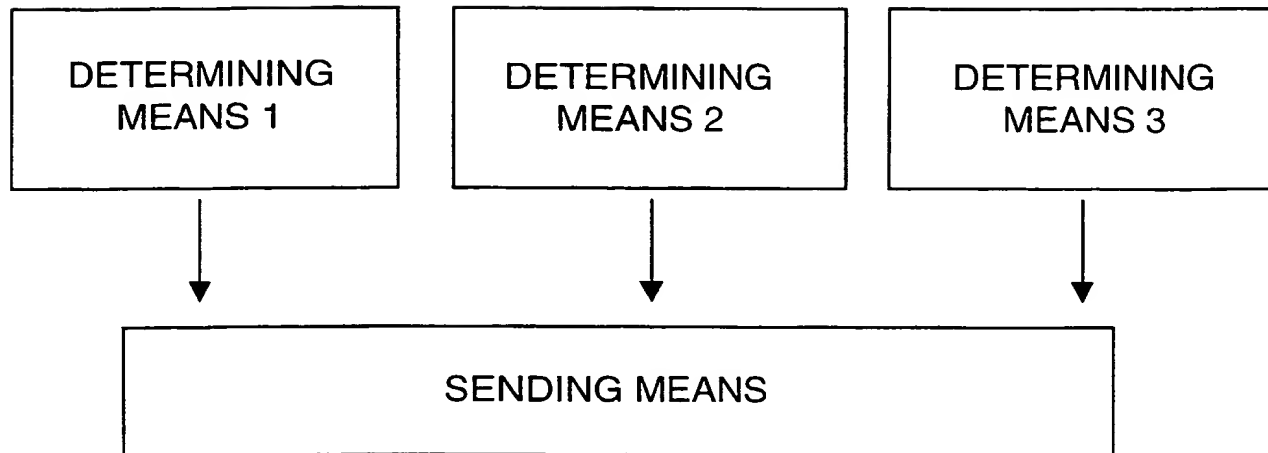


FIG. 9

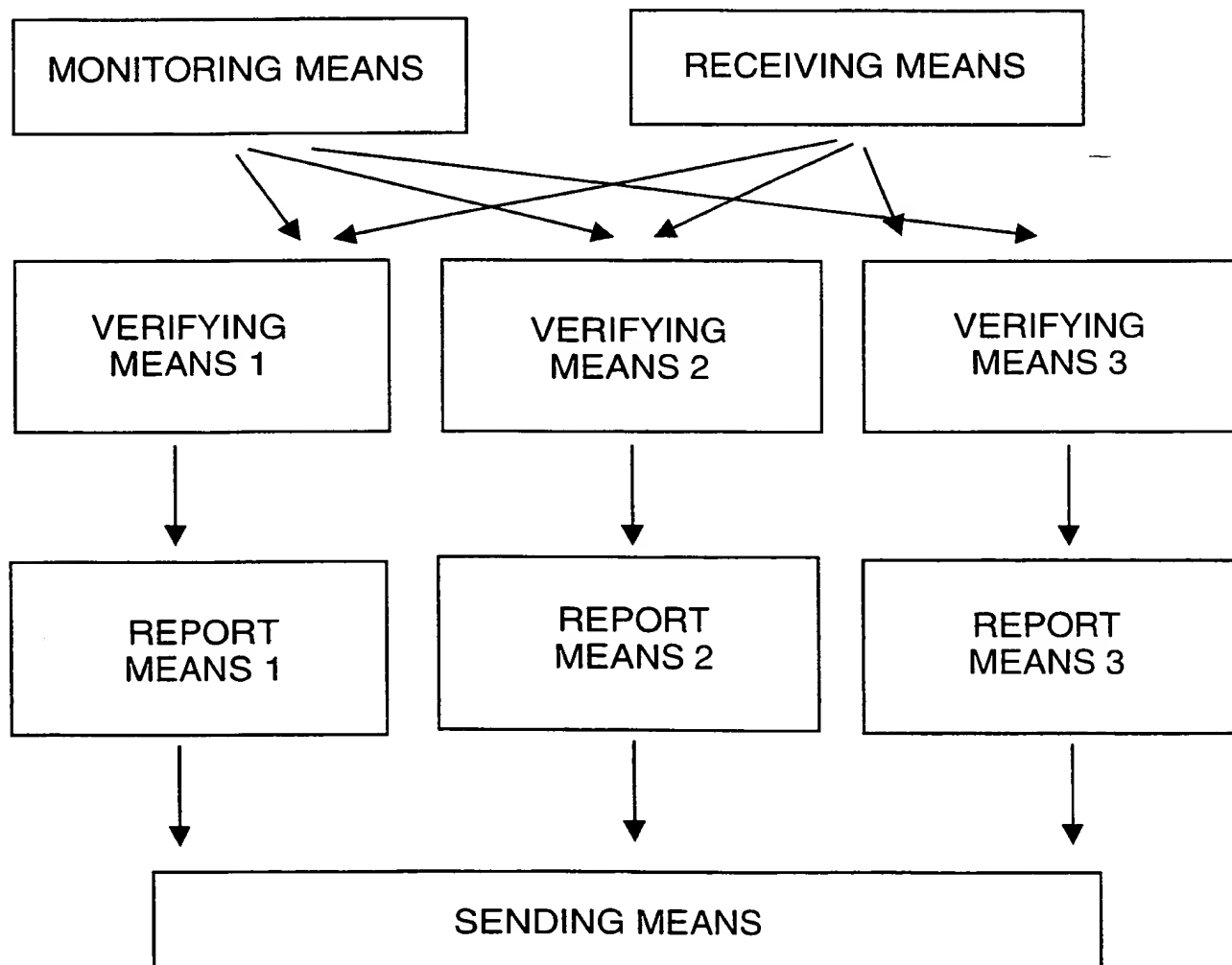


FIG. 10

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 99/00096

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/38

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9504419 A1 (BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY), 9 February 1995 (09.02.95), page 3, line 26 - page 5, line 20; page 9, line 20 - page 10, line 6; page 11, line 15 - page 12, line 24 --	1,26,28,29
A	US 5594949 A (CLAES H. ANDERSSON ET AL), 14 January 1997 (14.01.97), column 6, line 26 - column 7, line 7 --	1,26,28,29
P,A	WO 9857512 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 17 December 1998 (17.12.98), page 4, line 9 - line 11; page 4, line 19 - line 29 -- -----	1,26,28,29

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search

28 July 1999

Date of mailing of the international search report

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/FI 99/00096**

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